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TERRAIN FEATURES OF DRAINAGE BASINS IN THE SIERRA NEVADA WEST-SIDE SNOW ZONE

by Lucille Richards

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TERRAIN FEATURES OF DRAINAGE BASINS IN THE SIERRA NEVADA WEST-SIDE SNOW ZONE

by
Lucille G. Richards, ~~Research Forester~~

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U. S. ~~DEPARTMENT OF AGRICULTURE~~, FOREST SERVICE
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Figure 1.--Drainage basins included in inventory.

TERRAIN FEATURES OF DRAINAGE BASINS IN THE SIERRA NEVADA WEST-SIDE SNOW ZONE

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As part of a research program seeking improved water yield from the snow zone, an inventory was made of the ground and cover characteristics of the west side of the Sierra Nevada above 5,000 feet in elevation. We needed answers to questions such as: How much of the area is forested? How dense are the forests? How much of the area is bare ground or covered with brush? How steep are the slopes? Answers to these questions, obtained from a study of topographic maps and aerial photographs, have been summarized for the study area as a whole. 1/ This report presents a breakdown of such terrain features by individual drainage basins.

Details of the methods used in making the inventory have been published. 1/ Briefly, the procedure was as follows: Sample points were selected at the intersection of every 5 minutes of latitude and longitude on a grid extending the length of the Sierra Nevada from 36°00' in the south to 39°55' in the north, and from the 5,000-foot contour on the west to the crest of the Sierra Nevada on the east. Detailed topographic, vegetation, and land-use characteristics of 40-acre sample tracts having their southeast corners at these latitude and longitude intersections were determined from U.S. Geological Survey maps, Army maps, and aerial photographs. The inventory consisted of 331 tracts, or a total of 13,240 acres in twelve drainage basins (table 1). The basins included in the inventory are (fig. 1):

(1) Feather River - southern two-thirds
(2) Yuba River
(3) American River
(4) Mokelumne River
(5) Stanislaus River
(6) Tuolumne River
(7) Merced River
(8) San Joaquin River
(9) Kings River
(10) Kern River - northern half
(11) Kaweah River
(12) Tule River

Since the Kaweah and Tule River basins are both small in comparison to the other basins, they have been reported together in this summary.

1/ Richards, Lucille G. Forest densities, openings, ground cover, and slopes in the snow zone of the Sierra Nevada west-side. U.S. Forest Serv. Pacific Southwest Forest and Range Expt. Sta. Tech. Paper 40. 21 pp., illus. 1959.

SUMMARY OF RESULTS

Some generalization can be made of individual features of the drainage basins which may influence management to improve watershed conditions. These features include: forest areas subject to cutting for increased water yield, brushlands subject to type conversion for improved water yield 2/, and grasslands subject to management.3/

Feather River

The Feather River watershed in the northern part of the Sierra Nevada range has more brushland than any other west-side Sierra watershed. About 56 percent of the basin is open area (table 2) and 49 percent of this open area is brush (table 5). There is more grassland and less bare ground and rock in the Feather River watershed than in any of the others (table 5). The slopes are gentle, 94 percent of the slopes have a gradient of less than 40 percent (table 6). South-facing slopes predominate (table 7).

Yuba River

The Yuba River basin, which borders the Feather River on the south, has more open area than its northern neighbor (table 2), but not as much brushland (table 5). There is more rock and bare ground than in the Feather River watershed (table 5), and the slopes are a little steeper (table 6) with west-facing slopes predominating (table 7). The Yuba River watershed has more area in swamps than any of the other watersheds (table 5).

American River

The American River watershed falls between the Feather River and Yuba River watersheds in amount of open land (table 2). It contains less brushland than the Feather or Yuba watersheds but still has a large amount since 40 percent of the open area is brush covered (table 5). The slopes are steeper than in the Feather or Yuba watersheds, and 3 percent of the slopes have a gradient of more than 70 percent (table 6). The American River watershed has more south-facing slopes than the other watersheds (table 7).

Mokelumne River

More than half of the area of the Mokelumne River basin is forested (table 2), but the forests are not dense: 30 percent of the forested area is in the 15-39 percent density class (table 3). This watershed has less brush than the watersheds north of it, and less grass than

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2/ Anderson, Henry W., and Clark H. Gleason. Effects of logging and brush removal on snow water runoff. Internatl. Assoc. Sci. Hydrol. Paper No. 51: 478-489. 1960.

3/ Rice, Raymond M. Snow management in high Sierra range. Jour. Range Mangt. 12: 14-16. 1959.

any of the watersheds. The slope gradients are about average and south-facing slopes predominate.

Stanislaus River

The Stanislaus River watershed not only occupies the central position in the Sierra west-side, but is about average in most of its characteristics with one exception--it has the highest percentage of open area occupied by streams of any of the watersheds (table 5).

Tuolumne River

The Tuolumne River basin is exceeded only by the Kings River basin in the amount of area that is open and the percentage of open area occupied by rock and bare ground. In the Tuolumne River basin 64 percent of the area is open (table 2) and 60 percent of this is rock and bare ground (table 5). Only 0.4 percent of the area of the Tuolumne River basin has forests in the 70-100 percent density class (table 3).

Merced River

The Merced River watershed has about the same amount of open area as the Tuolumne River watershed, 64 percent (table 2), but does not have as much rock and bare ground (table 5). There is more area in grassland than in the watersheds to the south although not as much as in the Feather River watershed (table 5). The slopes are very gentle, 90 percent have a slope gradient under 40 percent (table 6). The Merced River watershed has the highest percentage of west-facing slopes and the lowest percentage of east-facing slopes of any of the watersheds (table 7).

San Joaquin River

The San Joaquin River basin is average in most of its characteristics. However, it has more lakes than most of the watersheds (table 5).

Kings River

Although the Kings River basin has the largest amount of open area of all of the watersheds, it has the least brush (table 5). The open area consists mainly of large openings greater than 1,056 feet across (table 4) which are made up of rock and bare ground. There is very little grass (table 5). The slopes are steep; 38 percent have a slope gradient of over 40 percent (table 6), and many are covered with talus (table 5). There are more east-facing slopes in the Kings River watershed than in any of the others.

Kern River

The Kern River basin, although bordering the Kings River basin, represents the opposite extreme in some of its characteristics. The Kern River basin has the highest amount of forested area; the Kings River basin has the lowest. Sixty percent of the area of the Kern River

watershed is forested, about 18 percent higher than the average for the Sierra west-side (table 2). The area which is not forested consists mainly of small openings less than 132 feet across (table 4), whereas the Kings River watershed has very few small openings. There is very little brush, but lakes occupy about 8 percent of the open area (table 5). Some slopes are steep, but most of them have a gradient of between 31 and 40 percent (table 6). East-facing slopes predominate, as in the Kings River watershed (table 7).

Kaweah and Tule Rivers

The Kaweah and Tule River watersheds were grouped because they are both small, lower elevation watersheds which do not extend to the crest of the Sierra divide. In some of their characteristics, they resemble northern Sierra watersheds more than the other southern Sierra ones. They contain the most forested area in the 70-100 percent density class even though the southern watersheds generally have few forests in this density class (table 3). There is more brush and less rock and bare ground (table 5) than in the nearby Kern River and Kings River watersheds, and there are fewer steep slopes (table 6).

Table 1.--Percent distribution of acreage sampled by drainage basins[1/]

Drainage basin	Acres sampled	Percent of samples
Feather R.	1,360.0	10.3
Yuba R.	880.0	6.6
American R.	1,280.0	9.7
Mokelumne R.	480.0	3.6
Stanislaus R.	960.0	7.3
Tuolumne R.	1,360.0	10.3
Merced R.	840.0	6.3
San Joaquin R.	1,800.0	13.6
Kings R.	1,880.0	14.2
Kern R.	1,720.0	13.0
Kaweah and Tule Rivers	680.0	5.1
Total	13,240.0	100.0

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

Table 2.--Percent distribution of forested and open area by drainage basins[1]

Drainage basin	Forested area[2]	Open area
Feather R.	43.6	56.4
Yuba R.	33.9	66.1
American R.	40.7	59.3
Mokelumne R.	52.6	47.4
Stanislaus R.	45.8	54.2
Tuolumne R.	36.2	63.8
Merced R.	36.3	63.7
San Joaquin R.	42.8	57.2
Kings R.	28.3	71.7
Kern R.	60.5	39.5
Kaweah and Tule Rivers	48.7	51.3
Average (area weighted)	42.1	57.9

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

2/ Forest with greater than 14 percent crown cover.

Table 3.--Percent distribution of forest density by drainage basins[1/]

Drainage basin	Density class in percent 2/				
	0-14	15-39	40-69	70-100	Total
Feather R.	56.4	19.9	18.9	4.8	100
Yuba R.	66.1	11.9	14.0	8.0	100
American R.	59.3	19.5	12.0	9.2	100
Mokelumne R.	47.4	30.0	14.3	8.3	100
Stanislaus R.	54.2	19.6	18.2	8.0	100
Tuolumne R.	63.8	20.0	15.8	0.4	100
Merced R.	63.7	12.9	23.4	0	100
San Joaquin R.	57.2	14.6	21.1	7.1	100
Kings R.	71.7	12.2	16.1	0	100
Kern R.	39.5	21.2	34.5	4.8	100
Kaweah and Tule R.	51.3	3.8	31.7	13.2	100
Average (area weighted)	57.9	16.8	20.2	5.1	100

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

2/ Canopy cover.

Table 4.--Percent distribution of openings by size class and drainage basins[1/]

Drainage basin	Less than 132 feet across 2/	Less than 132 feet across 3/	132-263 ft. across	264-527 ft. across	528-1,056 ft. across	Greater than 1,056 feet across	Total 4/
Feather R.	24.8	0.2	3.2	4.2	3.8	45.0	81.2
Yuba R.	17.8	0.2	1.7	5.2	15.2	43.8	83.9
American R.	21.4	0	0.3	1.2	1.8	56.0	80.7
Mokelumne R.	27.4	0	0.3	0	10.2	36.9	74.8
Stanislaus R.	24.0	0	0.6	5.4	5.4	42.8	78.2
Tuolumne R.	22.2	0	1.1	1.9	5.1	55.6	85.9
Merced R.	20.6	0.3	0.9	4.0	6.9	51.6	84.3
San Joaquin R.	22.4	0	0.9	3.2	7.1	46.0	79.6
Kings R.	15.6	0.1	0.6	2.9	3.9	64.1	87.2
Kern R.	32.3	0	0.4	1.1	4.3	33.7	71.8
Kaweah and Tule Rivers	18.0	0.4	0.7	2.1	2.9	45.2	69.3
Average (area weighted)	22.5	0.1	1.0	2.9	5.5	48.3	80.3

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.
2/ Collectively determined.
3/ Individually measured openings consisted of roads and streams.
4/ Percent of total area.

Table 5.--Percent distribution of cover in openings by drainage basins[1]

Drainage basin	Grass-herb	Brush	Trees	Crops	Rock-ground	Talus	Roads	Streams	Lakes	Swamps	Total
Feather R.	26.2	48.9	2.9	1.8	16.5	0	0.9	[2] 0.3	1.2	1.3	100
Yuba R.	15.8	44.0	3.2	0	33.6	0	0.5	0.3	0	2.6	100
American R.	13.6	40.2	4.1	0	37.7	0.3	0.1	0	4.0	0	100
Mokelumne R.	3.3	36.6	3.1	0	56.9	0	0.1	0	0	0	100
Stanislaus R.	15.5	31.8	3.6	0	47.8	0	0.6	0.7	0	0	100
Tuolumne R.	8.7	25.1	5.6	0	60.1	0	0.1	0.3	0.1	0	100
Merced R.	17.1	23.9	5.1	0	52.8	0	0.7	0.1	0.3	0	100
San Joaquin R.	8.0	26.0	5.0	0	49.8	3.2	0.2	0.1	7.1	0.6	100
Kings R.	4.3	16.5	4.6	0	62.0	10.5	0.1	0.3	0.9	0.8	100
Kern R.	16.3	18.5	5.4	0	49.2	2.4	0	0.3	7.9	0	100
Kaweah and Tule Rivers	7.4	36.2	5.8	0	44.7	4.0	0.9	0.6	0	0.4	100
Average (area weighted)	12.1	29.6	4.5	0.2	47.4	2.7	0.3	0.2	2.4	0.6	100

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

2/ Includes 0.2 percent "cover" of buildings.

Table 6.--Percent distribution of slope gradient by drainage basins[1/]

Drainage basin	Slope gradient in percent								Total
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	Over 71	
Feather R.	14.7	38.2	23.5	17.7	5.9	0	0	0	100
Yuba R.	0	31.8	27.3	18.2	13.7	4.5	4.5	0	100
American R.	6.3	28.1	21.9	28.1	3.1	3.1	6.3	3.1	100
Mokelumne R.	16.7	33.4	16.7	8.3	8.3	8.3	8.3	0	100
Stanislaus R.	16.7	45.8	20.8	8.3	0	4.2	4.2	0	100
Tuolumne R.	17.7	35.3	26.5	5.9	5.9	2.9	2.9	2.9	100
Merced R.	23.8	38.1	14.3	14.3	9.5	0	0	0	100
San Joaquin R.	20.0	28.9	15.6	17.8	13.3	0	0	4.4	100
Kings R.	12.8	17.0	8.5	23.4	8.5	12.8	4.2	12.8	100
Kern R.	11.6	16.3	18.6	34.9	9.3	2.3	2.3	4.7	100
Kaweah and Tule Rivers	0	29.4	11.8	35.2	5.9	11.8	0	5.9	100
Average (area weighted)	13.3	29.0	18.7	20.3	7.9	4.2	2.7	3.9	100

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

Table 7.--Percent distribution of slope azimuth by drainage basins[1/]

Drainage basin	Azimuth					Total
	North 316°-45°	East 46°-135°	South 136°-225°	West 226°-315°	Level	
Feather R.	26.5	23.5	32.4	17.6	0	100
Yuba R.	9.1	13.6	18.2	59.1	0	100
American R.	15.6	6.3	37.5	37.5	3.1	100
Mokelumne R.	25.0	16.7	33.3	25.0	0	100
Stanislaus R.	20.8	12.5	29.2	37.5	0	100
Tuolumne R.	17.6	14.7	32.4	35.3	0	100
Merced R.	19.0	4.8	14.3	61.9	0	100
San Joaquin R.	20.0	22.2	33.3	15.6	8.9	100
Kings R.	21.3	36.2	14.9	27.6	0	100
Kern R.	23.2	27.9	16.3	25.6	7.0	100
Kaweah and Tule Rivers	0	23.5	29.4	47.1	0	100
Average (area weighted)	19.0	20.3	26.0	32.3	2.4	100

1/ Sierra west-side above 5,000 feet, Latitudes 35°57-1/2' N. to 39°57-1/2' N.

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